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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/595,577	04/28/2006	Tomoyuki Ueno	039.0065	2964

29453 7590 06/16/2008

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EXAMINER	
HOBAN, MATTHEW E	
ART UNIT	PAPER NUMBER
1793	

MAIL DATE	DELIVERY MODE
06/16/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/595,577	UENO ET AL.	
	Examiner	Art Unit	
	Matthew E. Hoban	1793	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17 March 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4-12 and 14-42* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4-12 and 14-42* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

1. Claims 1, 2, 4-6, 14-17, 19-21, 23-27, 37, 39 rejected under 35 U.S.C. 102(b) as being anticipated by Gromnitskaya et al in their publication entitled "Mechanical behavior and microstructure of nanodiamond-based composite materials".

Gromnitskaya creates nanodiamond-SiC composites, where the nanodiamond powder used is a 4-6 micron powder, which undergoes grinding under pressure till it reaches 1-2 microns. This powder is polycrystalline and consists of **3-5 nm crystallites (grains)** See Paragraph 3, Column 1 page 1699- Column 2 paragraph 2). Compacts were made by infiltrating silicon metal into the diamond skeletal structure, which fully reacts with the Carbon in the diamonds, making SiC, with diamonds (See Column 2 paragraph 2 page 1699). The microhardness of these samples was between 75-100 GPa (See Table 1). Finally it is stated that silicon fully infiltrates the network of diamond and fills all pores. The density of a 28% SiC, 72% diamond composite was found to be 3.4 g/cc. The experimental density of such a composite based on the rule of mixtures would also be 3.4 g/cc, meaning that the overall porosity

of the sample was nigh zero, meaning that the open porosity would also be near zero and less than 1% (See Table 1).

Regarding Claim 1-2, 17, 37, 39: The carbon allotrope is diamond and it is present at 72%, and has a crystallite (grain) size of 3-5 nm. The ceramic phase is Silicon Carbide, which comprises the remainder of the composite.

Regarding Claim 4. 14: The composite has a density of 3.4g/cc, which is equal to the experimental density of such a composite found through the rule of mixtures.

Regarding claim 5, 15, 30: The hardness of the composite is between 75 and 100 GPa.

Regarding claim 6, 16, 19-21, 23-27: The ceramic phase comprises a carbide of Silica.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5.

6. Claims 1, 6, 17-28, 37 and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Keat in 4,157,897.

Keat teaches a bonded abrasive grinding element comprising diamond, 10-53 vol% graphite, and up to 60% of aluminum and silicon carbide (See Claim 1 and 4). Keat claims the graphite is flake graphite and has a particle size from 1-10 microns. When the vol% of this component is converted to wt%, it shares an overlapping range with the instant claims. Although, Keat's graphite is represented by a range that goes outside of that which is claimed, it also includes an

overlapping portion of the range., from 1-3 microns. One of ordinary skill in the art would be able to select from this portion of the range and arrive at the instantly claimed invention, making it obvious over the disclosure of Keat alone. The same situation goes for the amount of graphite used in the composite.

Regarding Claim 1: The composite comprises diamond, 10-53 vol% graphite, where the particle size is from 1-10 microns. This range of graphite size represents a substantially overlapping range with that of the claimed range.

Regarding Claim 6: Silicon carbide is used in the binder of Keat.

Regarding Claim 17-18: Both diamond and graphite are used, where graphite is present from 10-53 vol%.

Regarding Claim 19-28: The ceramic compositions used comprise both alumina and silicon carbide.

Regarding claim 37 and 38: The composite comprises both graphite and silicon carbide.

7. Claims 7-9, 29, 31-36 are also rejected under 35 U.S.C. 103(a) as being unpatentable over Keat in 5,453,105.

Keat teaches a bonded abrasive grinding element comprising diamond, 10-53 vol% graphite, and up to 60% of aluminum and silicon carbide (See Claim 1 and 4). Keat claims the graphite is flake graphite and has a particle size from 1-10 microns. When the vol% of this component is converted to wt%, it shares an overlapping range with the instant claims. Although, Keat's graphite is represented by a range that goes outside of that which is claimed, it also includes an overlapping portion of the range., from 1-3 microns. One of ordinary skill in the art would be able to select from this portion of the range and arrive at the instantly claimed invention, making it obvious over the disclosure of Keat alone. The same situation goes for the amount of graphite used in the composite.

Keat's hot pressing procedure is delineated in Column 6 of the patent in the section entitled "HOT PRESSING PROCEDURE". The components are loaded into the mold under an inert atmosphere of nitrogen gas and heated to 500C. Pressure is then applied to 1.5 tons per square inch and the temperature is then raised to 600C.

Keat's does not teach a composite having a porosity below one percent and also sinters at a temperature and pressure lower than that of the instant claims. However, it would be obvious to one of ordinary skill in the art to increase both the temperature and pressure of sintering in order to form a more dense composite. This would be especially motivated in the teachings of Keat since the composite is useful as an abrasive. Porosity decreases the hardness of a composite and makes it inferior. Keat states in claim 1 that the porosity of his composite must be below 10%, therefore porosity is a critical factor to his invention. One would further decrease this porosity to

a lower threshold by altering the processing and increasing the density during sintering, which is most commonly done by increasing both temperature and pressure. Therefore, one of ordinary skill would appreciate that sintering done at the temperatures and pressures found in the claims would obviously form a more dense compact compared to the parameters as set forth by Keat. One would then be motivated to use higher temperatures and pressures in order to make a more dense compact, since density and porosity are an important aspect in Keat's teachings. By increasing this pressure and temperature to a substantial degress, one would form a compact with less than 1% porosity.

8. Claims 7-12, 33 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gromnitskaya et al in their publication entitled "Mechanical behavior and microstructure of nanodiamond-based composite materials".

Gromnitskaya creates nanodiamond-SiC composites, where the nanodiamond powder used is a 4-6 micron powder, which undergoes grinding under pressure till it reaches 1-2 microns. This powder is polycrystalline and consists of **3-5 nm crystallites (grains)** See Paragraph 3, Column 1 page 1699- Column 2 paragraph 2). Compacts were made by infiltrating silicon metal into the diamond skeletal structure, which fully reacts with the Carbon in the diamonds, making SiC, with diamonds (See Column 2 paragraph 2 page 1699). The microhardness of these samples was between 75-100 GPa (See Table 1). Finally it is stated that silicon fully infiltrates the network of diamond and fills all pores. The density of a 28% SiC, 72% diamond composite was found to be

3.4 g/cc. The experimental density of such a composite based on the rule of mixtures would also be 3.4 g/cc, meaning that the overall porosity of the sample was nigh zero, meaning that the open porosity would also be near zero and less than 1% (See Table 1).

9. The composites of Gromnitskaya were produced by being pressed at 8 GPa, under a temperature regime that began by melting Silicon at 900C at this pressure. The temperature is then ramped up to 1700-1800C and the composite is held at this temperature for one minute. Therefore, the temperature of the composite goes through the regime of 800-1500C at a pressure of greater than 200 MPa and 1000MPa. Although the final sintering is at a higher temperature, the synthesis of Gromnitskaya goes through the temperature of 800-1500C at some point during its ramp up to 1700-1800C. Since the instant claims do not give a time for which sintering in the claimed temperature range should occur, this time could be very brief as in the case where the furnace was ramping up to a higher final temperature.

Gromnitskaya does not teach that a non-oxidizing atmosphere is used during sintering but this is inherent to the reference, since the products within the composite are both non oxidized. Elemental silica is used, which would vigorously transform into silica if the atmosphere were oxidizing. This is especially true at these high temperatures. It is therefore impossible to sinter the composites of Gromnitskaya under an oxidizing atmosphere, meaning that the atmosphere must be non-oxidizing

10. Claims 1, 6, 16-17, 19-21, 23-27, 40 and 42 rejected under 35 U.S.C. 103(a) as being unpatentable over Brandrup-Wognsen in 5,723,177.

Brandrup-Wognsen teaches a diamond composite containing from 3-60 vol% diamond in a matrix containing at least one hard carbide nitride or carbonitride of a metal of group IV, V, or VI (See Abstract). Brandrup-Wognsen states that the diamonds can have a grain size from 3-100 microns, which overlaps the range given by the instant claims. Furthermore, included in carbides and nitrides of group IV, V, or VI metals would be silicon nitride and lanthanum carbide. Both the diamond concentration and grain size overlap that which is instantly claimed. One of ordinary skill in the art could select from the portion of the overlapping range to create the instantly claimed invention. Therefore selection from this range is prima facie obvious.

Regarding claim 1: Brandrup-Wognsen teaches diamonds of 3-100 micron diameter at 3-60 vol%. Brandrup-Wognsen uses carbides, nitrides, and carbonitrides as the matrix of the composite.

Regarding claim 6, 16-17, 19-21, 23-27: Brandrup-Wognsen teaches using carbides and nitrides of IV, V, and VI metals in their composite, which would include carbides and nitrides of any of Si, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo and W.

Regarding claim 40: Brandrup-Wognsen teaches using carbides and nitrides of IV, V, and VI metals in their composite, which would include carbides and nitrides of any of Si, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo and W. This would include nitrides of Silicon or Silicon Nitride.

Regarding Claim 42: Brandrup-Wognsen teaches using carbides and nitrides of IV, V, and VI metals in their composite, which would include carbides and nitrides of any of Si, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo and W. This would include carbides of tantalum, or tantalum carbide.

11. Claim 40 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Keat in 4,158,897 in view of Brandrup-Wognsen in 5,723,177.

Keat teaches a bonded abrasive grinding element comprising diamond, 10-53 vol% graphite, and up to 60% of aluminum and silicon carbide (See Claim 1 and 4). Keat claims the graphite is flake graphite and has a particle size from 1-10 microns. When the vol% of this component is converted to wt%, it shares an overlapping range with the instant claims. Although, Keat's graphite is represented by a range that goes outside of that which is claimed, it also includes an overlapping portion of the range., from 1-3 microns. One of ordinary skill in the art would be able to select from this portion of the range and arrive at the instantly claimed invention, making it obvious over the disclosure of Keat alone. The same situation goes for the amount of graphite used in the composite.

Keat does not teach the use of silicon nitride as the matrix in his composite, where he teaches that silicon carbide is used instead.

However, Brandrup-Wognsen teaches that carbides and nitrides of IV, V, and VI metals can be used in diamond based/ceramic composite, which would include carbides and nitrides of Si.

Therefore, it would be obvious to replace silicon carbide with silicon nitride, based on the fact that both are hard ceramics and according to Brandrup are equivalent and interchangeable in such composites based on their properties. One would be motivated to alter the invention of Keat with the teachings of Brandrup-Wognsen based on the fact that the two ceramics are interchangeable and both have suitable properties in an abrasive.

Response to Arguments

12. Applicant's arguments with respect to claims 1-16 have been considered but are moot in view of the new ground(s) of rejection. The arguments were directed towards the inadequacy of other art applied before the amendments were submitted. The current amendments teach ranges of diamond, which are not anticipated by this prior art. Therefore, the applicant's arguments are moot in view of the new rejection. All rejections based on USC 112 are withdrawn based on the amendments made to the claim.

13. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37

CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew E. Hoban whose telephone number is (571) 270-3585. The examiner can normally be reached on Monday - Friday from 7:30 AM to 5 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jerry Lorengo can be reached on (571) 272-1233. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Jerry A Lorengo/
Supervisory Patent Examiner, Art Unit 1793

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